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Country Elevators

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COST
VOLUME RELATIONS
in the Spring Wheat Belt

By Francis P. Yager

Service Report No. 63

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FARMER COOPERATIVE SERVICE
U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON, D.C. 20250

Joseph G. Knapp, Administrator

The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, financing, merchandising, quality, costs, efficiency, and membership.

The Service publishes the results of such studies; confers and advises with officials of farmers' cooperatives; and works with educational agencies, cooperatives, and others in the dissemination of information relating to cooperative principles and practices.

* * * * *

This study was conducted under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

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Highlights

This publication provides guides for allocating costs between merchandising and storage operations. Elevator management can analyze its own operations by using the allocating procedure suggested here to determine just what its costs are in storing and merchandising grain.

Allocation of costs to different types of structures reflect that costs for storing or merchandising grain vary by type.

The amount of grain merchandised and stored by an elevator plays a vital role in determining costs per bushel for storing and merchandising.

Interest on investment, shrinkage, and quality deterioration of grain are costs that may or may not be included in determining the cost of merchandising and storing grain.

As a facilities grain volume increases, operating costs will not necessarily increase at a uniform rate, particularly cost of labor.

Careful consideration should be given new elevator design and equipment from the viewpoint of how the annual operating cost may be reduced for the merchandising and storage operation.

Country Elevators -- Cost-Volume Relations in the Spring Wheat Belt

by Francis P. Yager

This is a report on the influence of elevator size, volume, and sidelines on the cost of operating local elevators in the Spring Wheat Belt.

Unavailable storage capacity near production areas has created a problem of storing grain carried over from season to season. The cost of supplying sufficient storage capacity for the grain and ways to reduce this cost is important to the grain trade, farmers, and the U. S. Government.

Increased grain production, improved harvesting equipment, expanded trade areas, and improved roads and transportation methods -- coupled with the Government loan program -- have increased the need for faster receiving equipment, increased storage capacity, and greater flexibility and handling efficiency in the country elevator.

In the Hard Red Spring Wheat Belt, a country elevator will receive three or more different grains. This will influence the size and type of facility as well as the number of bins available for the storage operations.

Utilization of storage in the wheat belt is affected because several different grains are stored. As a result more space is needed to handle several grains compared to a single grain. Wheat is usually separated by protein content, and flaxseed contains a high percent of dockage and if not cleaned will occupy a large amount of space in relation to the number of bushels stored.

Note: The author expresses appreciation to the cooperative elevators of North Dakota that furnished basic data for this study, and to Stanley K. Thurston, formerly with the Grain Branch, Farmer Cooperative Service, and now with Agriculture Stabilization and Conservation Service, Data Processing Center, for helping guide the study in its early phases.

New elevator facilities represent a large outlay of money on which returns are normally spread over a long period of time. The fixed outlay associated with construction of elevator facilities generally remains constant regardless of the grain volume handled or stored.

This study can help management evaluate its own particular situation in its decision to build for the future.

Method of Analysis

We collected the cost information for this study from cooperative country elevators in North Dakota to determine what effect size of facility and volume of grain would have on the unit costs of storing and merchandising grain. Since storage and merchandising operations are different, this report indicates the various relationships between cost, volume, and size of facilities.

The cooperative elevators selected for the case study approach represented some of the most commonly found size and type facilities of small country elevators in the Hard Spring Wheat Belt. We considered the cost of facilities for the various models as representative of those existing during the late 1950's, when the data were collected. Case study analysis based on information acquired supplied much of the data on which this report was based.

Costs used in developing model operations were based upon operating statements, balance sheets and elevator records and from managers of the elevators selected.

We used the model approach in this study because country elevator costs obtained from audit reports and records of operations are usually not entirely comparable for a number of reasons, such as:

1. Variation in size of facilities and equipment.
2. Management practices.
3. Sideline operations.
4. Volume of grain stored and merchandised.
5. Location of elevator.
6. Variation in operating costs between areas.

In using different models in this report we recognize that many alternatives are open to people who are considering expanding their grain elevator facilities. Some of the facilities are more capable of carrying on one type of operation than another. Thus the operator must be in a position to estimate the volume of grain he can merchandise and store with the different types and sizes of facilities. He must match the job that needs to be done with the facility that best fits the situation.

Description of Elevator Models

We developed the elevator models from information received from contracting engineers, previous elevator projects, and case studies of actual elevators in North Dakota.

All models were operated in conjunction with the different buildings comprising the elevator facility. The model facility consisted of several different types of buildings as well as different physical layouts.

Several of the six different size models had the same basic unit for the main house. The first three digits of each model represent the total capacity of the elevator in thousands of bushels. A summary of the models used is as follows:

	Capacity and material		
Model	Main house	Added facilities	Total Bushels
100	40,000-bu. wood	Two 30,000-bu. wood	100,000
155	75,000-bu. wood	Five 16,000-bu. steel tanks	155,000
190	40,000-bu. wood	100,000-bu. + 50,000-bu. wood	190,000
265	45,000-bu. concrete	Two 110,000-bu. concrete	265,000
325	110,000-bu. concrete	(125,000-bu. concrete + (50,000-bu. wood, + (40,000-bu. flat steel Quonset	325,000
380	110,000-bu. concrete	(100,000-bu. wood + (40,000-bu. wood + (30,000 bu. wood + (100,000-bu. ten 10,000-bu. steel tanks	380,000

To the main house were connected various types and combinations of structures for storing and merchandising grain. A combination of different type structures is the building pattern that has been carried on by the small country elevators in the Spring Wheat Belt.

Each of the main elevator houses--40,000 to 110,000 bushels--was the drive-beside type. That is, each had a driveway separating the office, sample and electrical room, and main elevator. The driveway contained scales, doors on each end, truck hoist, and dump pit, all of them covered. This was by far the most prevalent elevator arrangement for newer facilities.

100,000-Bushel Model 100

This model contained a 40,000-bushel main house and two 30,000-bushel storage annexes. The complete facility was a wooden cribbed metal-clad structure. The main house was utilized in filling and emptying the storage annexes by use of conveyor equipment.

155,000-Bushel Model 155

The main house was a wooden cribbed metal-clad structure of 75,000 bushels. Additional storage facilities consisted of five steel tanks with a rated capacity of 16,000 bushels each. These tanks were filled by a conveyor from the main house. They were emptied by the use of portable equipment, and the grain was returned to the main elevator to be elevated for loading out.

190,000-Bushel Model 190

The main house was a 40,000-bushel wooden cribbed metal-clad structure. The two annex facilities of 100,000 bushels and 50,000-bushels were wooden cribbed metal-clad. They were filled and emptied by conveyor equipment from the main house.

265,000-Bushel Model 265

The main house was a 45,000-bushel concrete structure. The added facilities were composed of two 110,000-bushel concrete structures. They were emptied and filled by conveyors utilizing the main house.

325,000-Bushel Model 325

The main house was constructed of concrete and had a rated capacity of 110,000 bushels. Added facilities consisted of a 125,000-bushel concrete annex, a 50,000-bushel wood annex, and a 40,000-bushel steel Quonset structure. All facilities were emptied and filled by the use of the main house with the exception of the Quonset building, which was emptied and filled by the use of portable equipment.

380,000-Bushel Model 380

The main house was constructed of concrete and contained 110,000 bushels of storage space.

The facilities added consisted of a 100,000-bushel, a 40,000-bushel, and a 30,000-bushel wood cribbed metal-clad structure. Recently added were 10 steel tanks each with a capacity of 10,000 bushels each. All were emptied and filled utilizing the main house.

Design and Equipment

The design and equipment of the elevators built in an area more or less become standardized over time. Figures 1 through 6 in the appendix show the basic designs of the headhouse and the layout of each model. Table 1 shows a list of the equipment in each.

Individual facilities may vary from this basic design. Capacity of equipment may be different as well as the amount of equipment installed. This variation comes about because of operator preference, contractor's experience, and type of business for which the elevator was intended. Many times elevator operators choose to have more or faster handling equipment installed.

When a facility is built and equipped, a contractor usually can make provision in the plans and specifications for adding other equipment or for more storage. Usually the additional cost of providing, at the time of original construction, for expansion and installation of more equipment is small compared to the cost of making such additions later without having made provision for them.

The cost of constructing and equipping the various head houses used in the models varied from $2.14 a bushel for the 45,000-

Table 1.--Features of main elevator in each model 1/

Item		Model elevator					
		100	155	190	265	325	380
Capacity of main house	(bushels)	40,000	75,000	40,000	45,000	110,000	110,000
Type structure	(material)	Wood	Wood	Wood	Concrete	Concrete	Concrete
Bins	(number)	20	21	20	19	20	20
Legs	(number)	2	2	2	3	3	3
Elevator rate	(bu. per. hr.)	3,300	3,300	3,300	3,800	3,800	3,800
Leg motor size	(hp.)	15	15	15	20	20	20
Dump pit	(number)	1	1	1	1	1	1
Capacity of pit	(bushels)	400	400	400	500	500	500
Driveway	(number)	1	1	1	1	1	1
Length of truck scales	(feet)	60	60	60	60	60	60
Capacity of scales	(tons)	50	50	50	50	50	50
Compressor motor	(hp.)	5	5	5	5	5	5
Cleaners	(number)	2	2	2	2	2	2
Motor size	(hp.)	5; 7½	5; 7½	5; 7½	7½; 10	7½; 10	7½; 10
Seed treater	(number)	1	1	1	1	1	1
Automatic scales	(number)	1	1	1	1	1	1
Capacity of scales	(bushels)	10	10	10	15	15	15

1/ Other features found in the models were:
All steel leg casing and spouting
Two overhead driveway doors
Dust collection system
Hydraulic truck lift
Compressor motor--5 hp. for lift
Basement
Sump pump
Sample room
Electric room
General office
Private office
Vault
Seed treating bin and platform

bushel concrete head house in model 265 to $1.50 for the 110,000-bushel concrete head house in models 325 and 380.

The cost of the various types of buildings added to the main house varied from 88 cents a bushel for a 40,000-bushel wood annex with equipment in model 380 to 35 cents a bushel for the five steel tanks with 80,000-bushel capacity in model 155 (table 2).

General Assumptions

All models were assumed to be in relatively the same economic environment. Thus cost differences associated with location differences have been eliminated.

It was assumed that the models were operated under average conditions with respect to costs per unit of input (wages, property, power, taxes, and so forth).

All models operated year round on an 8-hour day and 6-day week. However, at times during the peak harvest season elevators would remain open longer.

Each model was assumed to be of a design and size that contained a sufficient number of bins and other necessary equipment for economic operation.

Models were not designed to be perfect but as realistic models or patterns of construction in the Spring Wheat Belt.

All models were operating a storage and merchandising operation. The merchandising operation included an approximate $30,000 sales volume for sidelines. Sideline sales included seed, fertilizer, farm chemicals, and other farm supplies and services such as cleaning and seed treating. Essentially the operation in the Spring Wheat Belt is one of merchandising and storing grain. However, the last several years have seen an increase in the volume of sidelines handled by many elevators.

The grain stored or merchandised was valued at $1.51 a bushel. The assumed composition of the grain volume stored or merchandised was 55 percent wheat, including durum, 27 percent barley, 10 percent flax, and 8 percent others (soybean, corn, and oats).

Volume of grain handled included grain merchandised and stored.

Table 2.--Estimated facility costs of model elevators

Model	Type [1] structure	Rated capacity	Cost [2]			Cost per bushel		
			Building	Equipment	Total	Building	Equipment	Total
		1,000 bu.		Dollars			Dollars	
100 [3]	Wood	40	$48,800	[4] $30,200	$79,000	$1.22	$0.76	$1.98
	Wood	30	19,200		19,200	.64		.64
	Wood	30	19,200		19,200	.64		.64
155 [3]	Wood	75	89,300	[4] 30,200	119,500	1.19	.40	1.59
	Five steel tanks	80	28,000	[5]	28,000	.35		.35
190 [3]	Wood	40	48,800	[4] 30,200	79,000	1.22	.76	1.98
	Wood	100	49,400		49,400	.49		.49
	Wood	50	31,600		31,600	.63		.63
265 [3]	Concrete	45	54,400	[4] 41,700	96,100	1.21	.93	2.14
	Concrete	110	86,300		86,300	.78		.78
	Concrete	110	86,300		86,300	.78		.78
325 [3]	Concrete	110	117,800	[4] 47,100	164,900	1.07	.43	1.50
	Concrete	125	77,600		77,600	.62		.62
	Wood	50	31,600		31,600	.63		.63
	Flat steel	40	14,400	[6]	14,400	.36		.36
380 [3]	Concrete	110	117,800	[4] 47,100	164,900	1.07	.43	1.50
	Wood	100	49,400		49,400	.49		.49
	Ten steel tanks	100	38,600		38,600	.39		.39
	Wood	40	35,400		35,400	.88		.88
	Wood	30	19,200		19,200	.64		.64

Note: All additions include necessary equipment for filling and emptying, utilizing facilities of main house unless otherwise noted.

[1] Wood elevators are cribbed structures with metal cladding.
[2] Equipment included in cost of building unless otherwise noted.
[3] Main house includes office, sample room, driveway, and electrical room.
[4] Includes office, sample room, and elevator equipment.
[5] Tanks are filled from main elevator but must be emptied by portable equipment.
[6] Must be filled and emptied by portable equipment.

Rated storage capacity was used as a base in figuring the percent of each model utilized for the storage of grain.

Expense items for each model were allocated to two functions--primary and secondary--at various volumes merchandised and stored. The primary function consisted of grain merchandising and handling as well as a $30,000 sideline activity. The secondary function was that of grain storage.

The expense items were allocated between primary and secondary functions, using case study information and on the basis that seemed the most logical.

The secondary function, that of storage, was charged with those portions of an expense that could be directly attributed to it. The remainder of the expense was charged to the primary function, which included any idle inputs.

Some of the expenses were allocated all to one function, while others were divided between the two. Specific assumptions made on individual expense items are discussed later for each expense.

A base volume was established for each model. The purpose of a base volume was (1) to provide a level at which costs could be compared between models and (2) to provide a base from which to allocate individual expense items for each model for the various volumes of grain stored or merchandised. Table 3 shows the base volume for each model.

Table 3.--Capacity-volume relationship for elevator models

Model	Base yearly volume			Turnover at total volume
	Stored 1/	Merchandised	Total	
		Bushels		Number
100	65,000	235,000	300,000	3.00
155	100,750	299,250	400,000	2.58
190	123,500	576,500	700,000	3.68
265	172,250	627,750	800,000	3.02
325	211,250	988,750	1,200,000	3.69
380	247,000	1,053,000	1,300,000	3.42

1/ Sixty-five percent of total capacity was utilized for storage.

Expenses

Tables 4 and 5 summarize the total and the per-bushel expense--fixed, variable, and nonoperating--of each model. The expense summary reflects the total grain volume stored and merchandised for each volume. The three groups of expenses differ in their response to volume change. Expenses associated with the yearly sideline sales volume of $30,000 are not discussed, since they remain the same for all models at all volumes.

In tables 4 and 5, cost of the merchandising and storage operation was determined by the expenses allocated to the operation. In actual practice, many elevators do not break their expenses down into the two operations. As a result, they have a difficult time determining the cost for merchandising and storing a bushel of grain. The most they are able to do is to tell how much it cost per bushel to operate the complete facilities.

The larger models have greater total fixed expenses but are able to keep their per-bushel fixed cost down in merchandising grain. Consider a base volume of 1,300,000 bushels for model 380 with 247,000 bushels stored and 1,053,000 bushels merchandised. The fixed cost then is 1.03 cents a bushel for grain merchandised.

On the other hand, consider a base volume of 300,000 bushels for model 100, with 65,000 bushels stored and 235,000 bushels merchandised. Then the fixed cost is 2.26 cents a bushel. This is an indication that a small elevator, as well as a large one, must have a high volume to have a low fixed cost per bushel of grain merchandised.

In the storage operation, fixed expense plays an important role in the cost of storing a bushel of grain. Per-bushel fixed cost for storage among the models varied from a high of 5.31 cents a bushel in model 100 to 3.54 cents a bushel in model 380. The cost of storing a bushel of grain in all the models did not always decrease as the models became larger.

Some factors that contributed to the variations in cost among the models were: (1) Different construction costs for the different buildings comprising the models, (2) assumption made on building use, (3) variations in insurance rates among the different type structures in the models, and (4) assumptions made in the allocation of costs.

Table 4.--Total cost separated into fixed, variable, and nonoperating expenses by model and function

Model 1/	Volume merchan-dised	Merchandising function costs				Volume stored	Storage function costs				Total volume	Total expenses
		Fixed	Variable	Non-operating	Total		Fixed	Variable	Non-operating	Total		
	Bushels	Dollars				Bushels	Dollars				Bushels	Dollars
100	235,000	$5,297	$ 11,143	$ 6,305	$22,745	65,000	$ 3,452	$ 3,498	$ 3,205	$10,155	300,000	$ 32,900
155	299,250	6,303	12,087	7,630	26,020	100,750	3,748	3,723	4,028	11,499	400,000	37,519
190	576,500	6,657	17,599	8,705	32,961	123,500	4,778	4,971	4,902	14,651	700,000	47,612
265	627,750	8,616	18,440	11,039	38,095	172,250	8,333	4,763	8,937	22,033	800,000	60,128
325	988,750	10,246	24,435	14,170	48,851	211,250	7,759	5,292	8,601	21,652	1,200,000	70,503
380	1,053,000	10,814	25,064	14,881	50,759	247,000	8,735	6,870	9,492	25,097	1,300,000	75,856

1/ Sixty-five percent of total capacity was utilized for storage.

Table 5.--Per-bushel cost separated into fixed, variable, and nonoperating expenses by model and function

Model 1/	Volume merchandised	Merchandising function costs				Volume stored	Storage function costs			
		Fixed	Variable	Nonoperating	Total		Fixed	Variable	Nonoperating	Total
	Bushels	Cents per bushel				Bushels	Cents per bushel			
100	235,000	2.26	4.74	2.68	9.68	65,000	5.31	5.38	4.93	15.62
155	299,250	2.11	4.04	2.55	8.70	100,750	3.72	3.69	4.00	11.41
190	576,500	1.16	3.05	1.51	5.72	123,500	3.87	4.02	3.97	11.86
265	627,750	1.37	2.94	1.76	6.07	172,250	4.84	2.76	5.19	12.79
325	988,750	1.04	2.47	1.43	4.94	211,250	3.67	2.50	4.07	10.24
380	1,053,000	1.03	2.38	1.41	4.82	247,000	3.54	2.78	3.84	10.16

1/ Sixty-five percent of total capacity utilized for storage.

Allocation of Expenses

The accuracy of expense allocations in a model operation depends upon knowledge of actual operations and practical judgment. In allocating expenses, it is not intended to show year-to-year variation but rather to illustrate cost differences for different volumes and various amounts stored.

Model expenses were grouped into fixed, variable, and nonoperating expenses.

Fixed expenses are those that must be paid regardless of volume. These expenses are related to facilities and property valuation.

Variable expenses by their definition indicate they vary with changes in volume of business. Some of the expenses respond slowly to volume change, while others respond more proportionately to such changes.

Nonoperating expenses are interest on long-term capital [1], shrinkage, and quality deterioration. These expenses are separated from the others because management often does not realize how important they are. Separating them emphasizes their influence on total costs.

Fixed Expenses

Fixed expenses of the elevator models were depreciation, insurance on buildings and equipment, interest on long-term capital, property taxes, grain tax, bonds and licenses, and site rent. Expenses were allocated separately for each expense item at base volumes handled and stored (table 3).

All expenses with the exception of the grain tax would be incurred regardless of volume handled or stored. Managers generally can do nothing to reduce total fixed expenses. However, the fixed expense per unit is reduced when volume increases.

Depreciation

Depreciation is one of the major fixed expenses. In this study, cost of the facilities and equipment in each model was determined, and the straight-line method of depreciation with a zero scrap value was used. The depreciation rates used are a combination of the rates that were prevalent in the area and those suggested by the Internal Revenue Service.

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[1] Includes deferred liabilities and member equity capital.

Depreciation expense was first calculated separately for building and equipment because of the different rates used. Allocation of the expense to the two functions was made separately for each model.

A rate of 3 percent was used in calculating depreciation on all main elevator houses, which included concrete and metal-clad wooden cribbed elevators. The main house included office, vault, sample, and electrical room.

All other facilities added to the main elevator arrangement (concrete, wood, steel, and flat storage) were depreciated at the annual rate of 4 percent. This rate included the necessary equipment required to fill and empty the added facilities where applicable (table 6).

The equipment in the main house was depreciated at 10 percent. This included items such as truck scales, legs, distributors, cleaners, manlifts, sump pump, office equipment, sample-room apparatus and other items needed to operate.

The depreciation expense on building allocated to the storage operation was based upon the intended use of the building. The last building listed in table 6 under each model was used first in the storage operations. In this manner each preceding building was utilized until the desired level of storage capacity was reached. In some cases this involved using several bins in a structure for storage and remaining capacity for the merchandising function. In this case, that part of the structure utilized for storage was allocated to the cost of storage.

Allocation of the depreciation expense of equipment to the storage function was handled somewhat differently. Inasmuch as the elevator equipment was used primarily to merchandise grain, a higher percent of total equipment depreciation was charged to the merchandising function.

The charge to the storage function was based upon the relationship that existed between the volume of grain stored and the total volume handled for the model. The remaining expense was allocated to the merchandising function.

Table 6.--Calculation of annual depreciation expense for model elevators

Model	Type structure	Capacity	Rate of depreciation		Total depreciation expense
			Building	Equipment	
	Material	Bushels	Percent		Dollars
100	Wood	40,000	3	10	$ 4,484
	Wood	30,000	4	1/	768
	Wood	30,000	4	1/	768
155	Wood	75,000	3	10	5,699
	5 Steel tanks	80,000	4	1/	1,120
190	Wood	40,000	3	10	4,484
	Wood	100,000	4	1/	1,976
	Wood	50,000	4	1/	1,264
265	Concrete	45,000	3	10	5,802
	Concrete	110,000	4	1/	3,452
	Concrete	110,000	4	1/	3,452
325	Concrete	110,000	3	10	8,244
	Concrete	125,000	4	1/	3,104
	Wood	50,000	4	1/	1,264
	Flat steel Quonset	40,000	4	1/	576
380	Concrete	110,000	3	10	8,244
	Wood	100,000	4	1/	1,976
	10 steel tanks	100,000	4	1/	1,544
	Wood	40,000	4	1/	1,416
	Wood	30,000	4	1/	768

1/ Equipment included in cost of building

Table 7 shows the allocation of depreciation expense between functions when each model handled a specific volume of grain and utilized 65 percent of its capacity for grain storage.

Table 7.--Depreciation expense of model elevators allocated by functions

Model 1/	Total volume of grain handled	Depreciation expense by functions		
		Storage	Merchandising	Total
	1,000 bushels		Dollars	
100	300	$2,373	$3,647	$6,020
155	400	2,622	4,197	6,819
190	700	3,249	4,475	7,724
265	800	6,303	6,403	12,706
325	1,200	5,680	7,508	13,188
380	1,300	6,144	7,804	13,948

1/ Sixty-five percent of total capacity was utilized for storage.

Personal Property Tax

There was lack of uniformity among counties on the property tax rate and assessments. Since most of the elevators were constructed on railroad-leased land, it was assumed that each model would be assessed as personal property rather than real property.

In order to obtain a uniform rate and assessment for the various models, all were taxed at the rate of $1.11 per $100 of original value.

The method for allocating personal property tax for buildings and equipment between the storage and merchandising function was the same as in allocating depreciation (table 8).

Grain Tax

The taxable inventory on April 1 was estimated to be 25 percent of total storage capacity of each model. The inventory was estimated to contain 55 percent wheat, 27 percent barley, 10 percent flax, and 8 percent other grains.

The grain tax on inventory was 30 cents per 100 bushels of grain. This was allocated as an expense to the merchandising operations. This is included in the allocation of the personal property tax in table 8.

Table 8.--Personal property and grain tax of model elevators allocated by operations

Model 1/	Personal property tax by operation			Total volume of grain handled
	Storage	Merchandising 2/	Total	
	Dollars			1,000 bu.
100	$567	$811	$1,378	300
155	670	1,083	1,753	400
190	813	1,105	1,918	700
265	1,600	1,582	3,182	800
325	1,438	2,008	3,446	1,200
380	1,556	2,142	3,698	1,300

1/ Sixty-five percent of total capacity was utilized for storage.
2/ Includes grain tax.

Insurance -- Building

Insurance expense includes fire and extended coverage on building and equipment plus burglary and liability insurance.

The amount of insurance coverage on all models was 80 percent co-insurance.

Insurance rates for the different types of structure vary widely because of the difference in risk the insurance company must assume.

The following rates were used in this study:

Type structure	Rate per $100
Metal-clad wooden cribbed	$ 1.00
Quonset steel building	.60
Steel tanks	.26
Concrete	.23

It would be well when planning to build an elevator for management to consult reliable insurance companies to see that fire and safety features are incorporated into the new facility and thus assure low insurance rates.

The same procedure was used in allocating insurance expense as that used in allocating depreciation expenses on buildings and equipment.

Another insurance cost incurred was a $500 burglary policy at an estimated premium of $26 a year. Each model carried a public liability policy for $25,000/$50,000 for bodily injury and $5,000 for property damage, at an estimated annual cost of $55. These premiums were all allocated as a cost to the merchandising operation (table 9).

Table 9.--Fire and extended coverage insurance expense 1/ and other coverage for model elevators allocated by operation

Model 2/	Insurance valuation 3/	Expense by operation		Total expense
		Storage	Merchandising 4/	
		Dollars		
100	$ 93,920	$ 408	$ 612	$ 1,020
155	118,000	317	778	1,095
190	128,000	586	775	1,361
265	214,960	265	310	575
325	230,800	476	373	849
380	246,000	838	459	1,297

1/ Rounded to nearest dollar.
2/ Sixty-five percent of total capacity was utilized for storage.
3/ Valued at 80 percent of original cost.
4/ Includes $81 premium for a $500 burglary and a $25,000/$50,000 and $5,000 public liability policy.

Bonds and Licenses

A manager's bond is another fixed expense. The amount of the bond and cost varied among facilities. For this study a $4,000 manager's bond was estimated to cost $88. The cost was considered to be the same for all models. It was divided between merchandising and storage and allocated on the basis of volume stored to volume handled.

An elevator operating in North Dakota pays $10 a year for warehouseman's license. This was allocated on the basis of volume stored to volume handled.

In addition to the warehouseman's license, the State required all elevators to furnish a bond in support of the warehouseman's license. The amount of the bond was determined at the rate of $5,000 for each 25,000 bushels of storage capacity or fraction thereof. A minimum bond of $10,000 was required.

The cost of the bond for the model elevators was estimated at the following rates:

Amount of bond	Rate per $1,000
First $10,000	$4.50
Next 10,000	2.80
Next 10,000	2.50
Excess	1.60

Allocation to storage was on the basis of storage capacity utilized with the remainder as an expense to the merchandising function. Table 10 shows the expense allocation of manager's bond, warehouseman's license, and warehouse bond between the two functions.

Table 10.--Specific expenses of model elevators allocated by operations

Model 1/	Cost of bonds and licenses by operation 2/			Cost of site rent by operation		
	Storage	Merchandising	Total	Storage	Merchandising	Total
		Dollars			Dollars	
100	$69	$102	$171	$35	$125	$160
155	94	110	204	45	135	180
190	91	121	212	39	181	220
265	111	125	236	54	196	250
325	117	135	252	48	222	270
380	134	142	276	63	267	330

1/ Sixty-five percent of total capacity was utilized for storage.
2/ Includes allocation of manager's bond, warehouseman's license, and warehouse bond.

Site Rent

It was assumed that all model elevators leased land from the railroads on a long-term lease. The annual cost varied with location and size of area leased. The large facilities usually occupied more land and paid more for it.

The site rent expense was divided between the operations and allocated on the basis of volume stored to volume handled. See table 10 for allocations as divided between the two functions.

Variable Expenses

Variable expenses make up a large part of total expenses. The expenses that respond slowly to volume change may often be set by the manager as in the case of donations and advertising. Directors' fees, repairs, and travel are others that are slow in response to volume change.

The degree of variation differs among the so-called variable expenses. For this reason, each variable expense item was allocated separately.

Personnel Expenses

Personnel expense includes salaries and wages of employees needed to operate the elevator. Included in personnel expenses as other expenses are social security, unemployment compensation, and workmen's compensation insurance.

The manager's, assistant manager's, and bookkeeper's salaries were allocated to the storage function on the basis of volume stored to volume handled. This included other expenses as well. The remaining portion of their salaries and other labor expense were allocated to the merchandising function, table 11 and table 12.

Regular personnel requirements of the different models varied from two to four persons with extra help required from time to time. This, of course, depended upon volume handled (table 13). Employees in all models were assumed to be efficient.

Responsibilities of different employees increased as grain volume and elevator size went up.

The manager kept the books until the volume handled exceeded 500,000 bushels. Then a full-time bookkeeper was hired. In

Table 11.--Estimate of total personnel expense of model elevator by operation

Model 1/	Expense by operation		
	Storage	Merchandising	Total
		Dollars	
100	$ 1,688	$ 6,319	$8,007
155	2,119	6,726	8,845
190	2,032	10,137	12,169
265	2,675	10,400	13,075
325	2,240	14,782	17,022
380	2,476	14,848	17,324

1/ Sixty-five percent of total capacity was utilized for storage.

Table 12.--Breakdown of annual personnel expenses of model elevators

Model	Expense by employee					Other expenses 1/	Total 2/
	Manager	Assistant manager	Bookkeeper	First elevator man	Extra help		
				Dollars			
100	$4,500	$3,000	-	-	$208	$299	$8,007
155	4,800	3,300	-	-	416	329	8,845
190	5,100	3,600	$2,400	-	624	445	12,169
265	6,000	3,600	2,400	-	624	451	13,075
325	6,300	3,600	2,400	$3,300	832	590	17,022
380	6,600	3,600	2,400	3,300	832	592	17,324

1/ Social Security--calculated at 3 percent on first $4,800 of employee's wages, Unemployment compensation--three-tenths of 1 percent on first $3,000 of employee's wages. Workman's compensation insurance--rate of 64 cents per $100 of payroll.

2/ Rounded to nearest dollar.

Table 13.--Employee requirements expressed in man-months at specified volumes handled by model elevators

Model 1/	Volume handled 2/	Requirement by employee				
		Manager	Assistant manager	Book-keeper	First elevator man	Extra labor
	1,000 bu.	Man-months				
100	300	12	12	3/	-	1.0
155	400	12	12	3/	-	2.0
190	700	12	12	12	-	3.0
265	800	12	12	12	-	3.3
325	1,200	12	12	12	12	3.6
380	1,300	12	12	12	12	3.9

1/ Sixty-five percent of total capacity was utilized for storage.
2/ The increase in man-month requirements resulting from volume increases may occur at different volume levels than those shown.
3/ Manager keeps books.

addition to the duties as manager, he also helped the assistant manager run the elevator.

The assistant manager handled sidelines and the elevator with help from the manager until volume handled exceeded 900,000 bushels, then an elevator man was employed. Extra help was hired to do special jobs during peak movement of grain.

Advertising

Advertising expense included ads placed with local newspapers, radio, and TV stations relating to feed, fertilizer, and other farm supplies. A charge of $500 was made to all models since all had a yearly sideline sales volume of $30,000. This was allocated to the merchandising operation.

Dues and Subscriptions

Dues and subscriptions covered the amounts spent for membership in farm organizations, various trade organizations, civic groups, trade publications, market news service, newspapers and other similar media.

Size of the elevator and volume of grain handled did have some influence upon the amount spent. Storage utilization did not influence such costs. Models 100 and 155 were allocated $70 each, models 190 and 265 were allocated $150 each, and models 325 and 380 were allocated $300 each. Allocation was all made to the merchandising function.

Exchange (bank service charge)

This expense was influenced to some degree by the size of the elevator and volume of grain handled. Exchange was a charge made by the bank for handling the elevator's account, drafts, collections, and services performed for the elevator. Allocation of this expense was all to the merchandising function.

Heat

Management in most of the elevators utilized fuel oil for heating the office. An allocation of $250 was made to each model for heat. Since the elevator was assumed to do $30,000 worth of sideline sales each year, as well as merchandising grain, the heat expense was all allocated to the merchandising function.

Interest on Seasonal Capital

Seasonal capital was that capital needed to operate the merchandising function. Seasonal capital was used to buy grain during peak movements, to pay for labor, repairs, and farm supplies, and to finance accounts receivable.

The amount of seasonal capital depends upon volume of grain handled, price per bushel, demands for settlement, ability to ship and to settle accounts, amount of money received on drafts, and money invested in inventories. Seasonal capital was required for approximately 2 months of the year.

See table 14 for seasonal capital requirements and interest cost. An interest rate of 6 percent was used to determine the cost per year. The capital needed was acquired from banks or from commission companies. Interest expense on seasonal capital was allocated to the merchandising function.

Table 14.--Estimated seasonal capital requirements and interest cost by model elevators

Model	Capital required	Interest cost 1/
	Dollars	
100	$25,800	$258
155	32,400	324
190	35,200	352
265	59,100	591
325	63,500	635
380	67,600	676

1/ Interest 6 percent for 2 months.

Legal

Legal expense is usually a small item. It remains fairly fixed but variation will occur under circumstances associated with reorganization, financing, and other legal matters. A fixed amount of $30 was allocated to the merchandising function of each model.

Telephone and Telegraph

Telephone expense includes local service and long-distance calls relating to merchandising, handling, sideline sales, and other business. Telegraph expense was generally relatively unimportant.

An allocation of $375 was made to model 100, $400 to model 155, $425 to model 190, $450 to model 265, $475 to model 325, and $500 to model 380, for yearly telephone expense. This expense was allocated to the merchandising function.

Water

Water was used almost entirely in the office. It was a relatively small expense for all models. An estimated expense of $50 was assumed for each model. Allocation was all to the merchandising operation.

Miscellaneous Expenses

In this item are included expenditures that could not be put in with other expenses. Some of the items included are protein and seed tests, freight, express, and collections.

Total miscellaneous expense was allocated to the merchandising function. This expense was estimated to be $150 for each model. Table 15 indicates the various amounts allocated.

Table 15.--Estimate of specific variable expenses of model elevators 1/

Item of expense	Expense by model 2/					
	100	155	190	265	325	380
			Dollars 3/			
Advertising	$500	$500	$500	$500	$500	$500
Dues and subscriptions	70	70	150	150	300	300
Exchange	400	500	1,350	1,350	1,450	1,450
Heat	250	250	250	250	250	250
Interest--seasonal capital	258	324	352	591	635	676
Legal	30	30	30	30	30	30
Telephone and telegraph	375	400	425	450	475	500
Water	50	50	50	50	50	50
Miscellaneous	150	150	150	150	150	150

1/ Allocated directly to the merchandising operation.
2/ Sixty-five percent of total capacity was utilized for storage.
3/ Financial reports used as a basis.

Auditing

The auditor's expense in preparing an audit varies with the number and type of business transactions. This expense is influenced to some degree by the volume of grain, sideline sales, and bookkeeping methods utilized in the operation.

Allocation to the storage function was based on volume stored to total volume handled for each model with the remainder allocated to the merchandising function (table 16).

Table 16.--Estimate of specific variable expenses of model elevators 1/

Item of expense	Expense by model 2/					
	100	155	190	265	325	380
	Dollars 3/					
Auditing	$500	$600	$650	$700	$800	$900
Directors' fees	300	300	300	300	300	300
Donations	50	50	50	50	50	50
Elevator supplies	400	500	800	900	1,000	1,100
Lights	156	156	246	246	246	246
Meetings and member relations	100	100	100	100	100	100
Office supplies	350	400	450	500	1,000	1,000
Scales	50	50	50	50	50	50
Travel and convention	150	200	250	275	300	325
Repairs and maintenance	800	900	1,000	1,100	1,200	1,300

1/ Allocated to storage operation on basis of volume stored to total volume. Remainder considered expense of merchandising.
2/ Sixty-five percent of total capacity was utilized for storage.
3/ Financial reports used as a basis.

Directors' Fees

The expense item for directors' fees was assumed to be $300 for each model. The directors attended board meetings incurred expenses for travel and received a fixed allowance for each meeting. Each board was composed of 5 men attending 10 meetings a year.

Allocation to the storage function was based on volume of grain stored to total volume handled.

Donations

Contributions made to various charitable and civic organizations varied widely among the elevators. The variations in donations depended upon the condition of the business as well as the attitude of the management.

A donation of $50 was used for each model. This expense was allocated to the storage function on the basis of grain stored to total volume handled. The remainder was allocated to the merchandising function.

Elevator Supplies

Elevator supplies included petroleum products for machinery, refills for fire extinguishers, tags, sacks, brooms, scoops, masks, goggles, rodent control, and many other items necessary for the operating the elevator.

This expense was allocated for each model to the storage function on the basis of volume of grain stored to total volume handled. The remaining expense was allocated to the merchandising function.

Lights

Light expense included the cost of lighting the elevator, office space, sample room, and electricity for the water heater. Variations in this expense between models is largely due to difference in capacity of each model and rates for electric power.

Distribution of the cost between the two functions was based on volume stored to total volume handled.

Meetings and Member Relations

The expense connected with meetings and membership relations includes such items as rent for the meeting place, entertainment, refreshments, prizes, meeting notices, calendars, printing costs for operating statements and balance sheets, and other such expense incurred for the benefit of the members.

An expense of $100 was assumed for each model. Allocation to the two functions was based on volume of grain stored to total volume handled.

Office Supplies

Office supplies expense include postage, warehouse receipts, tickets, stationery, bookkeeping and accounting supplies, machine service, and other supplies needed in the office.

Allocation between the two functions was based on volume stored to total volume handled.

Scales

State inspectors checked scales once a year for accuracy. They charged a fee for each inspection. All scales used were assumed to be of the same type. Greater use of each scale resulted in a need for more frequent inspections and adjustments.

A scale expense of $50 was budgeted to each model, which included the fee charged by the State. Allocation between functions was based on volume stored to total volume handled.

Travel and Conventions

The manager, directors, and employees of the elevator incurred travel expense.

This expense included such items as annual meetings at regional grain cooperatives, district meetings, schools (i.e. grain grading, bookkeeping) and calling on patrons to collect overdue accounts. It was allocated between the two operations on the basis of volume stored to volume handled.

Repairs and Maintenance

Repairs and maintenance of facilities and equipment varies from year to year. Variations are due to factors such as size, condition of buildings and equipment, volume handled, and availability of time and money for repairing the properties.

Allocation by operation was based on volume stored to volume handled.

Power

Total power consumed by all models varied with the connected horsepower, number of times grain was elevated, amount of grain cleaned, and volume of grain merchandised and stored.

All grain was considered to have been rough cleaned regardless of whether it was merchandised or stored.

Stored grain was turned at least three times during the year in all models except the grain in the five steel tanks in Model 155, and that in the Quonset building in Model 325.

A minimum monthly power charge was made to each model. It was based upon connected horsepower. The assumed connected horsepower for each model is shown in table 17. The minimum charge per month for all models was 50 cents a kilowatt of connected load.

Table 17.--Estimate of yearly power cost and horsepower of model elevators

Model 1/	Power cost by operation			Connected horsepower
	Storage	Merchandising	Total	
		Dollars		
100	$209	$253	$462	75½
155	157	317	474	58
190	387	609	996	75½
265	581	1,015	1,596	137½
325	626	1,442	2,068	145
380	762	1,460	2,222	177½

1/ Sixty-five percent of total capacity was utilized for storage.

Power costs chargeable to the grain storage operation were estimated by the percent of the total kw.-hrs. consumed for the storage function. In figuring the power costs, it was assumed that management turned grain stocks during months when receipts and shipments were lowest. In so doing, the minimum monthly power costs would be utilized fully. Table 17 shows allocation by functions.

The rate schedule used to determine the monthly power cost was as follows:

Kilowatt hours		Cents per kw-hr.
First	150	6.0
Next	150	5.0
Next	700	4.0
Next	1,000	3.3
Excess		2.8

Power consumption for each model was first estimated for a year by functions. Total kw.-hrs. consumed were divided into monthly consumption figures in order that the rate schedule could be applied and also to determine if the minimum monthly charge was met. By so doing, it was assumed that power requirements were the same for all months. However, in actual practice power consumption varies between months.

Insurance--Grain and Supplies

The insurance premium for fire and extended coverage on grain inventories depends upon rates, value of grain, and place of storage. Insurance is usually carried on the provisional adjustment plan, under which a blanket policy is taken out. Premium adjustments are made from time to time for amounts and value of grain held in inventories. In this study the insurance rates were the same as those for building and equipment. An insurable value of $1.51 a bushel was used for all grain.

The insurance expense for the storage function was based on building use. The building carried last for each model listed on page 8 was utilized first in the storage function. Each preceding building was utilized for storage until the desired storage capacity was obtained. To arrive at the insurance cost on the stored grain, the insurance rate for the building was used times the value of the grain stored in the particular building. Table 18 shows the allocation of insurance expense on grain and supplies by function.

Table 18.--Insurance expense of supplies, stored and merchandised grain by elevator model

Model	Insurance valuation 1/	Insurance expense by operation 2/		
		Storage 3/	Merchandising 4/	Total
			Dollars	
100	$113,250	$982	$251	$1,233
155	175,538	627	334	961
190	215,175	1,865	387	2,252
265	300,112	598	192	790
325	368,062	1,538	213	1,751
380	430,350	2,612	499	3,111

1/ 100 percent coverage on grain valued at $1.51 a bushel.
2/ Rounded to nearest dollar.
3/ Sixty-five percent of total capacity was utilized for storage.
4/ 10 percent of total capacity plus $100 premium for farm supplies.

An estimated 10 percent of total capacity was used for grain in the merchandising function. To determine the insurance costs for the merchandising function, rates on the building or buildings above the desired level utilized in storage were used. This expense was allocated directly to the merchandising function.

Insurance expense of $100 was incurred for coverage of all sideline inventories for each model. All was allocated directly to the merchandising part.

Nonoperating Expenses

This study includes three additional expenses. They are shrinkage, quality deterioration, and interest on long-term capital (total assets minus current liabilities). They are separated from other expenses because of their importance and to show their influence on total cost by function.

Another reason they are listed separately is that on actual elevator operating statements they are not listed as expenses, if at all. Quality deterioration does occur under conditions related to management practices. Interest on long-term capital depends upon the type of facilities constructed and varies from elevator to elevator.

Shrinkage

In most operating statements, you will not find a cost item labeled shrinkage. However, shrinkage is present in the form of fewer bushels sold or in a lower gross margin per bushel. Shrinkage may occur in the form of moisture loss from grain, in drying, spillage, insects, and rodents.

In this study, shrinkage was estimated to be one-fourth of 1 percent a bushel for all grain merchandised plus an additional one-fourth of 1 percent for the volume of grain stored. 2/ Grain was valued at $1.51 a bushel in figuring the cost of shrinkage by functions in each of the models (table 19).

2/ Thurston, Stanley K. and Mutti, R.J. Cost-Volume Relationships for New Country Elevators in the Corn Belt. Service Report 32, Farmer Cooperative Service, U. S. Dept. of Agr. 1957.
Hall, Thomas E. and others, New Local Elevators: Cost-Volume Relations in the Hard Winter Wheat Belt. Service Report 12, Farmer Cooperative Service, U. S. Dept. of Agr. 1955.

Table 19.--Specific expenses of model elevators allocated by operation

Model 1/	Shrinkage expense by operation			Quality deterioration 2/
	Storage	Merchandising	Total	Storage
	Dollars			Dollars
100	$491	$ 887	$1,378	$162
155	761	1,130	1,891	252
190	932	2,176	3,108	309
265	1,300	2,370	3,670	431
325	1,595	3,733	5,328	528
380	1,865	3,975	5,840	618

1/ Sixty-five percent of total capacity was utilized for storage.
2/ No quality deterioration assumed for merchandising operation because of good management.

Quality Deterioration

Loss of quality on grain sold or stored is like shrinkage; it is very seldom reflected on the operating statement. Today management assumes more risks for grain quality maintenance than ever before. In this study, quality deterioration for the storage operation was set at one-fourth of 1 cent a bushel for the amount of grain stored. 3/ All expense of quality deterioration was allocated directly to the storage function (table 19). Quality deterioration for the merchandising function was not calculated, since each model was assumed to be under good management.

Interest on Long-Term Capital

Long-term capital is equal to net assets (total assets minus current liabilities). It is capital regularly used throughout the year and consists of deferred liabilities and ownership equity. It has many characteristics of a fixed expense but will be considered as a nonoperating expense for emphasis. Interest on seasonal capital is discussed as a variable expense.

The expense reflected on the operating statement usually pertains to that incurred on deferred liabilities. However, the interest

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3/ Thurston, Stanley K. and Mutti, R.J. Cost-Volume Relationships for New Country Elevators in the Corn Belt. Service Report 32, Farmer Cooperative Service, U. S. Dept. of Agr. 1957.

on ownership equity may be shown as stock dividends, stock credits or--as in the case of reserves and surplus--no interest cost.

The proportion of long-term capital used varies among elevators. Interest on long-term capital was charged on the full amount of the investment at the rate of 5 percent (table 20). This cost was assumed to exist whether long-term capital for the fixed assets was borrowed or provided by the owners.

Table 20.--Long-term capital used and interest expense by operation

Model 1/	Assets			Total interest expense 2/	Interest expense by operation	
	Fixed	Others	Total		Merchandising	Storage
				Dollars		
100	$117,400	$42,000	$159,400	$7,970	$5,418	$2,552
155	147,500	42,800	190,300	9,515	6,500	3,015
190	160,000	43,800	203,800	10,190	6,529	3,661
265	268,700	48,800	317,500	15,875	8,669	7,206
325	288,500	49,800	338,300	16,915	10,437	6,478
380	307,500	50,800	358,300	17,915	10,906	7,009

1/ Sixty-five percent of total capacity was utilized for storage.
2/ A 5 percent rate was used.

Interest expense on the operating statement is reflected as an expense only if paid to outside sources, but true cost should include the interest on the owner's equity. If this was a new facility and interest payments were not met, the facility would not be in operation the next year. The interest expense with this assumption needs to be recalculated every year to determine the interest costs for the facilities each year.

Long-term capital was broken down into fixed and other assets. Fixed assets included the initial cost of buildings and equipment. Other assets included capital needed to carry on the merchandising operation.

Fixed assets were allocated between the storage and merchandising operation. The interest on the last building listed on page 8 under each model was used for the storage operation. In this way, each preceding building was utilized until the desired level of storage capacity was reached. In many cases, this involved using bins in other buildings. The interest chargeable to storage in that case was calculated on the percent of the building occupied by the storage operation. The remaining interest on buildings was allocated to merchandising. The interest on machinery was allocated to storage on the proportion of volume stored to total volume, the remainder being charged to merchandising.

Conclusions

The procedures used in allocating expenses to elevator models in this study was to determine what it cost to perform various functions. Management of different types of facilities may want to do likewise. This resulted in the following conclusions on deciding capacity of new elevators and equipment for a given location in the Spring Wheat Belt.

In planning for a new elevator facility or the construction of additional space, an appraisal of the volume of grain to be merchandised and stored in the area is important.

In construction of facilities, it is better to underbuild rather than overbuild. Provision should be made at the time of construction, however, for the addition of more capacity at a later date if the need arises.

In selecting equipment to install in a facility, it is better to select equipment large enough to handle future needs. It is rather difficult and expensive to alter the elevator after it has been built.

Flat-storage facilities are less flexible and less able to handle a large volume on a daily basis because they have fewer bins and have a slower receiving and shipping rate.

Sidelines are important for several reasons: (1) They absorb idle time of employees, putting it to profitable use for the elevator, (2) they render added services to the farmer in the area, and (3) they provide an opportunity to gain additional grain volume from the farmers who purchase sidelines from the elevator.

As a facility is able to handle an increased volume, operating costs will not necessarily increase at a uniform rate.

Size of the elevator and percent of capacity utilized affects the operating costs. Some costs are fixed and will be incurred regardless of the volume of grain.

Different-size elevators have their own particular advantages and disadvantages in operating costs and storing and merchandising grain.

Per-bushel costs for fixed expenses change at different rates in storing grain depending on type of building in which grain was stored.

Small elevators are at a disadvantage on fixed costs compared to elevators of larger size when both are storing at their base volumes.

Fixed cost per bushel of grain handled or stored declines with volume increases.

In one given location, variable expenses do not change significantly at comparable annual volumes.

Employee requirements and responsibilities increase with the increase in size of elevators and volume handled.

Personnel expenses are a major variable expense.

Per-bushel costs for variable expenses change at different rates for different-type structures.

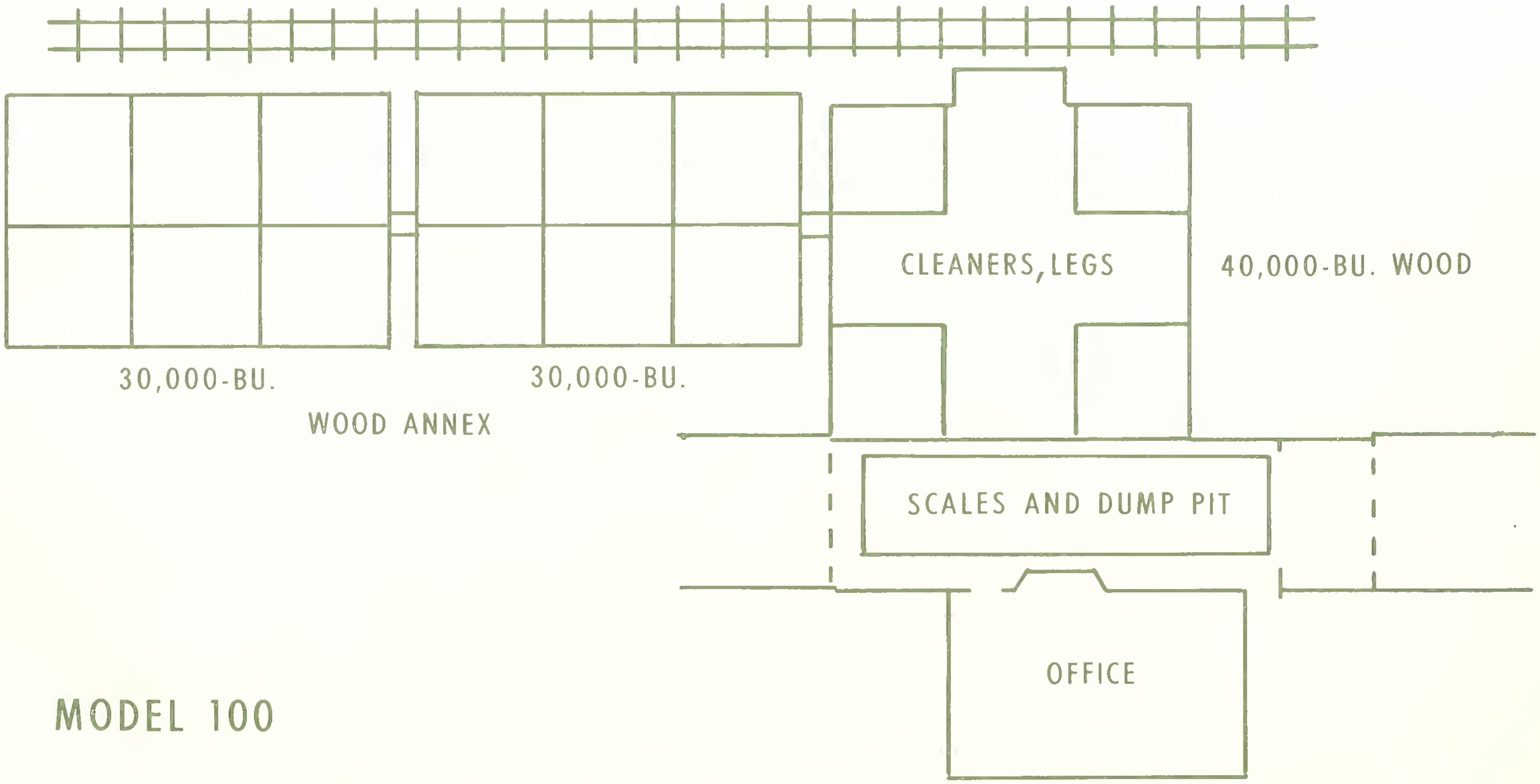
Variable cost per bushel for grain merchandised is higher than fixed cost per bushel.

Costs usually not shown on operating statements include shrinkage, quality deterioration, and interest on long-term capital. These costs cannot be ignored in the merchandising and storing operation.

The greater turnover in relation to the capacity used for merchandising decreases the expense per bushel.

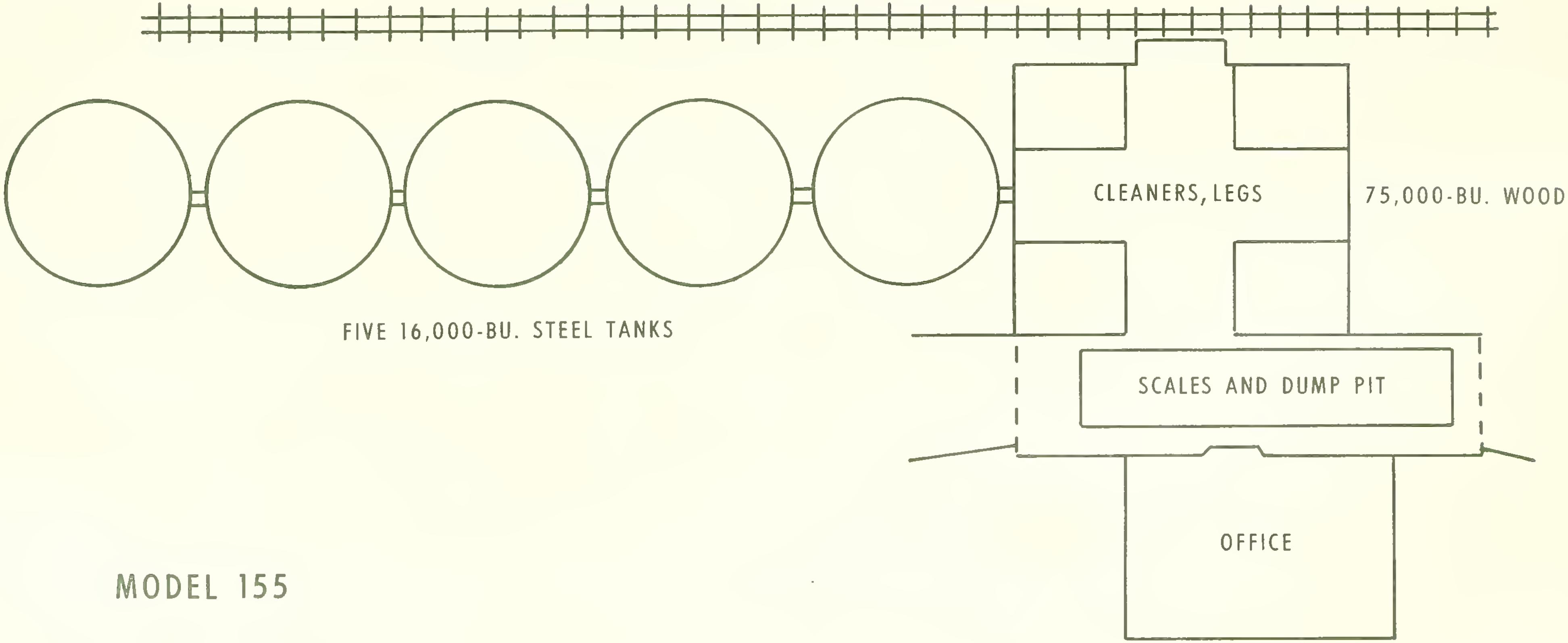
Appendix

FIG 1.—ELEVATOR LAYOUT, 100,000-BUSHEL WOOD



MODEL 100

FIG. 2.—ELEVATOR LAYOUT, 75,000-BUSHEL WOOD
WITH FIVE 16,000-BUSHEL STEEL TANKS



MODEL 155

FIG. 3.— ELEVATOR LAYOUT, 190,000-BUSHEL WOOD

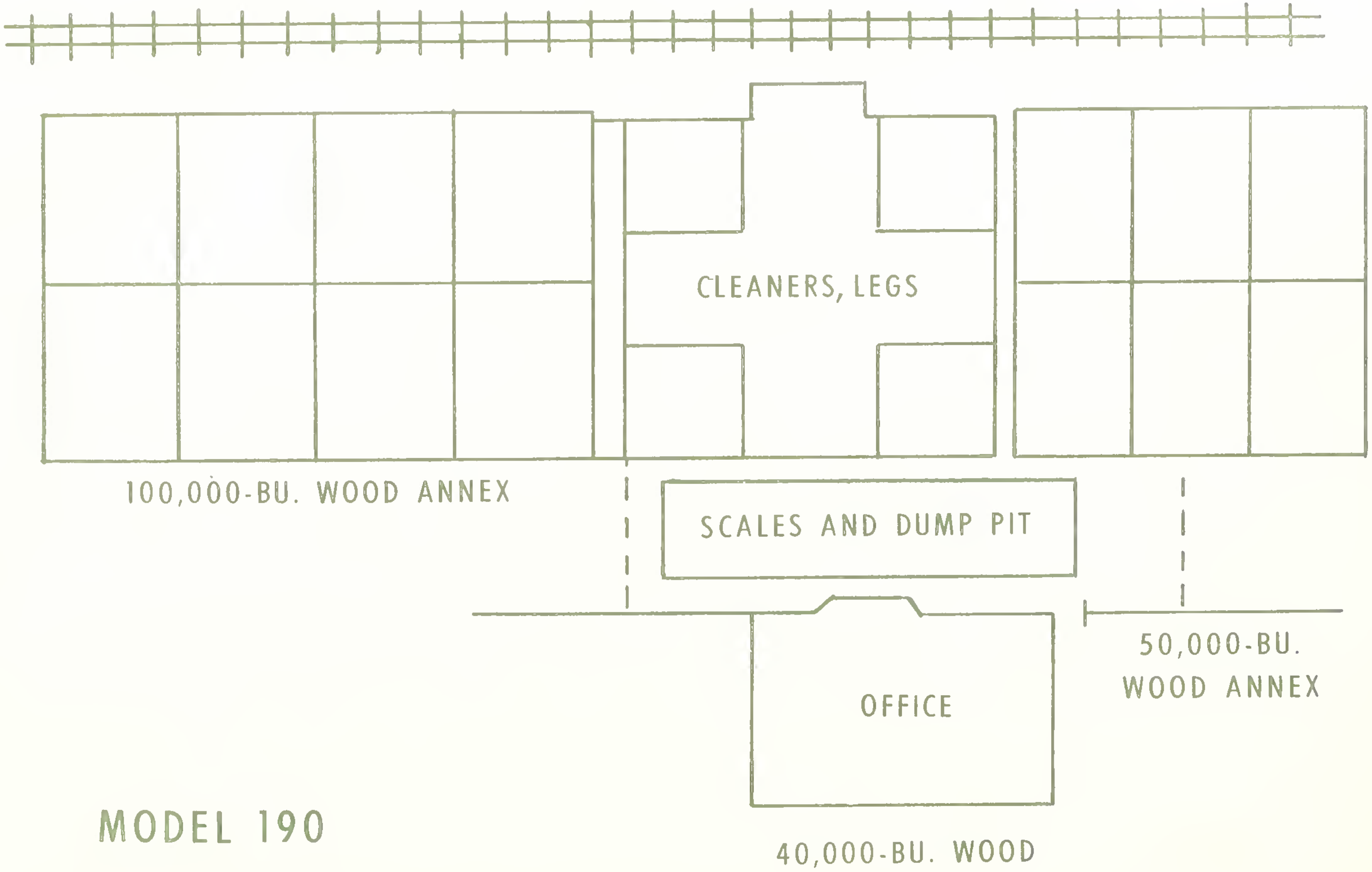


FIG. 4.—ELEVATOR LAYOUT, 265,000-BUSHEL CONCRETE

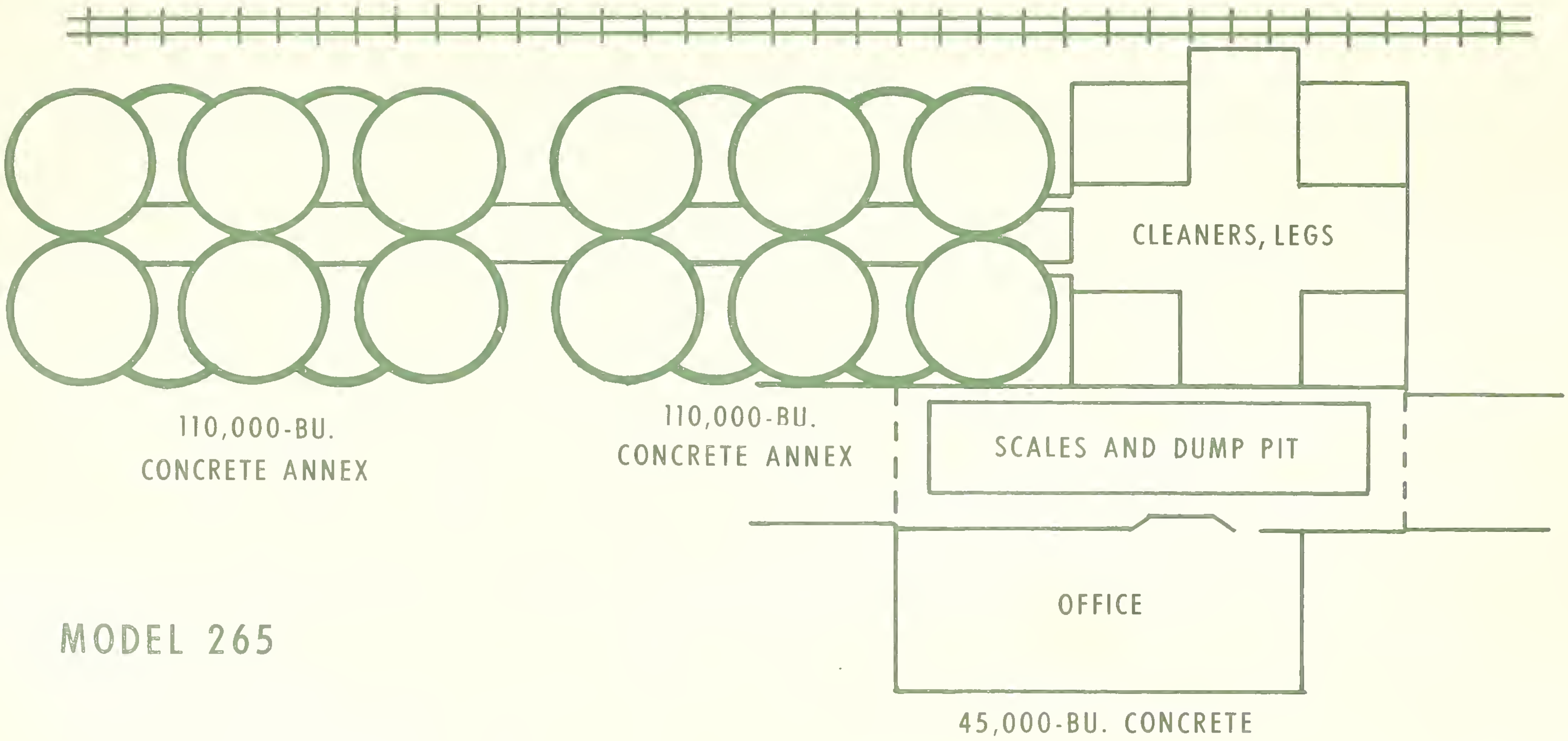
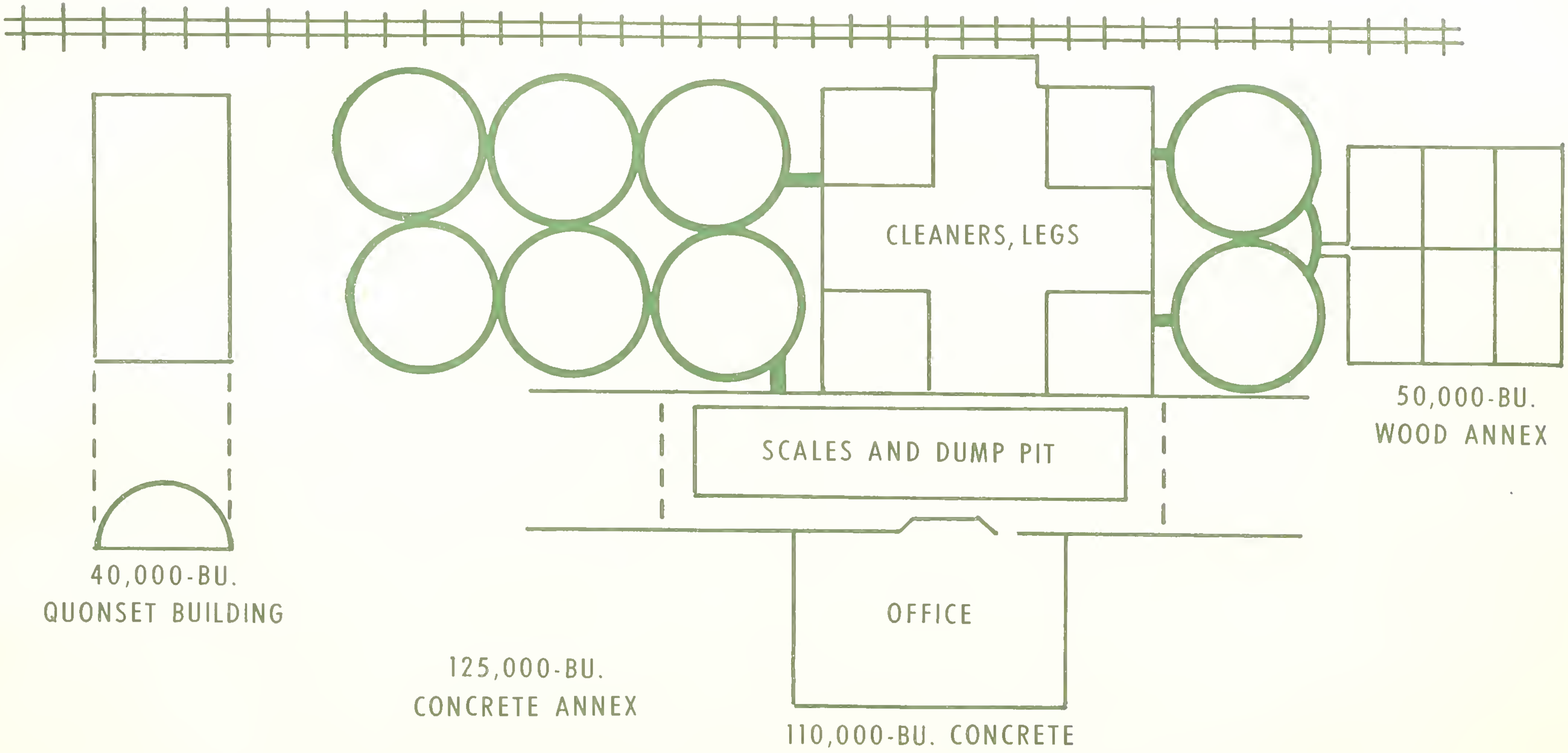


FIG. 5.— ELEVATOR LAYOUT, 235-BUSHEL CONCRETE, 50,000-BUSHEL WOOD, AND 40,000-BUSHEL QUONSET BUILDING



MODEL 325

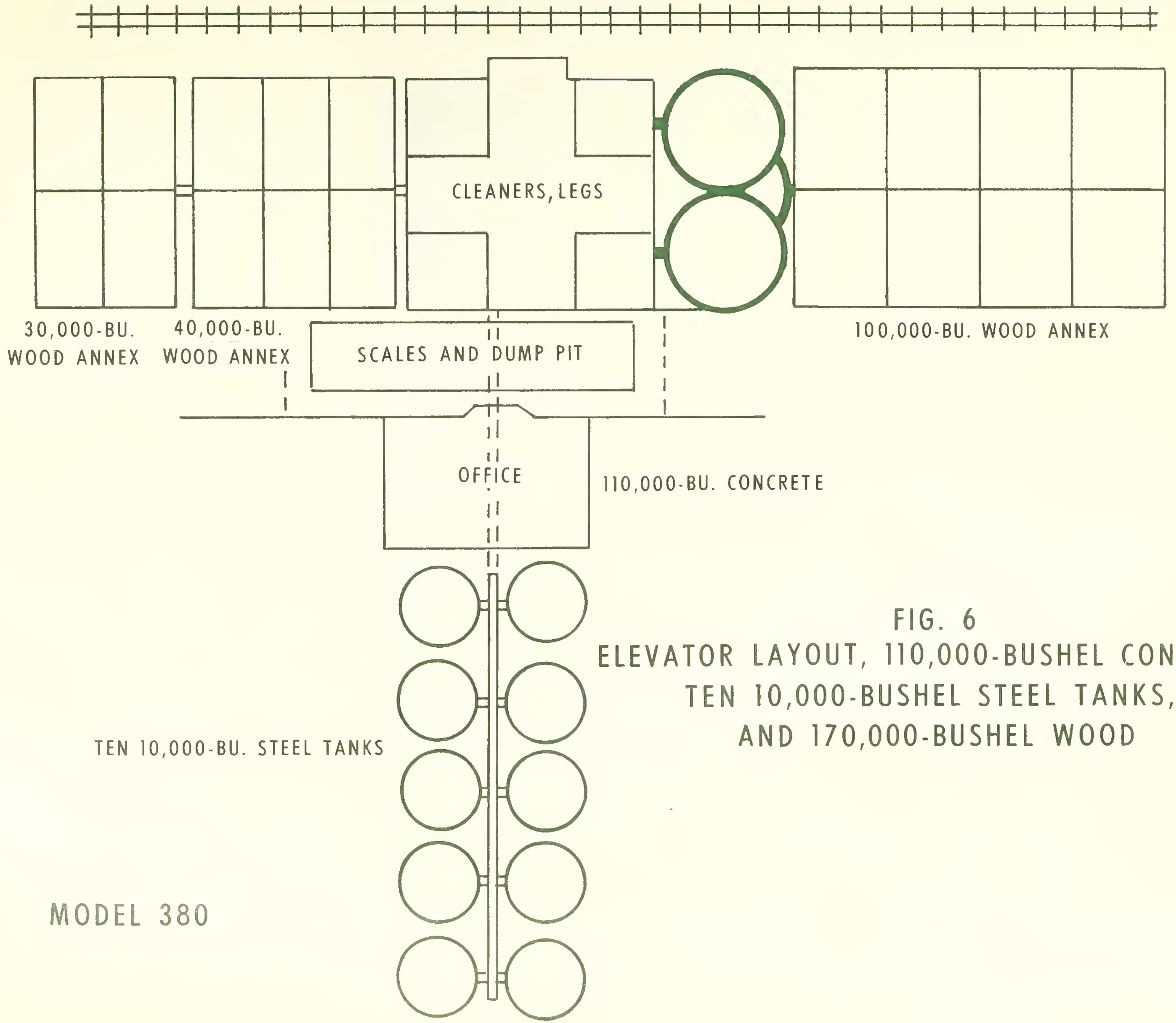
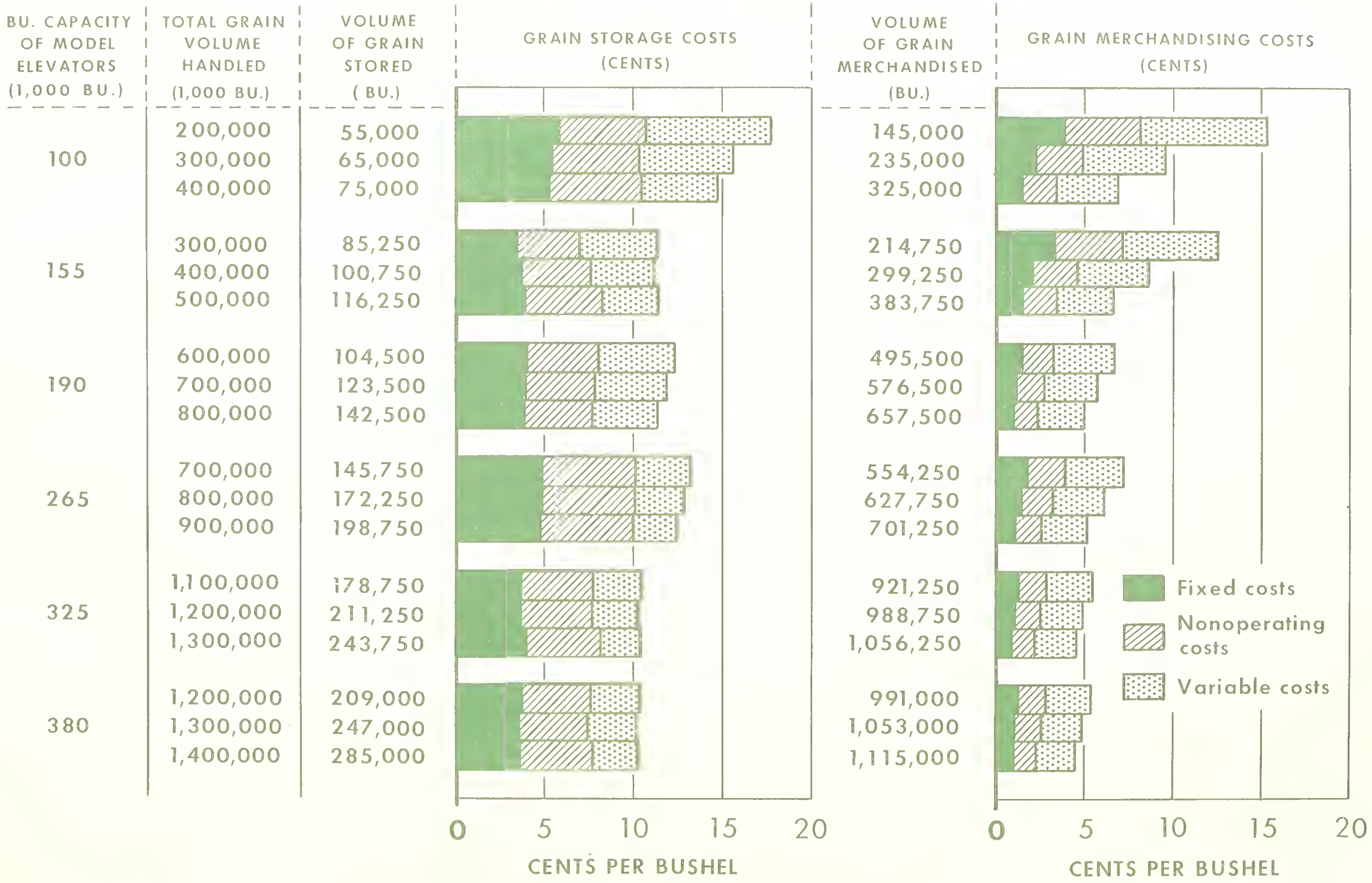


FIG. 6
ELEVATOR LAYOUT, 110,000-BUSHEL CONCRETE, TEN 10,000-BUSHEL STEEL TANKS, AND 170,000-BUSHEL WOOD

Fig. 7

RELATION OF COST TO VARIOUS EXPENSES AT DIFFERENT VOLUME LEVELS, BY MODEL ELEVATOR



BU. CAPACITY OF MODEL ELEVATORS (1,000 BU.)	TOTAL GRAIN VOLUME HANDLED (1,000 BU.)	VOLUME OF GRAIN STORED (BU.)	VOLUME OF GRAIN MERCHANDISED (BU.)
100	200,000	55,000	145,000
	300,000	65,000	235,000
	400,000	75,000	325,000
155	300,000	85,250	214,750
	400,000	100,750	299,250
	500,000	116,250	383,750
190	600,000	104,500	495,500
	700,000	123,500	576,500
	800,000	142,500	657,500
265	700,000	145,750	554,250
	800,000	172,250	627,750
	900,000	198,750	701,250
325	1,100,000	178,750	921,250
	1,200,000	211,250	988,750
	1,300,000	243,750	1,056,250
380	1,200,000	209,000	991,000
	1,300,000	247,000	1,053,000
	1,400,000	285,000	1,115,000

Appendix table 1.--Method used in allocating fixed expenses to the models

Expense item	How expenses were allocated to:	
	Storage	Merchandising
Depreciation:		
Building	Use	Remainder
Equipment	Volume stored/total volume	Remainder
Property tax:		
Building	Use	Remainder
Equipment	Volume stored/total volume	Remainder
Grain tax	None	All
Insurance:		
Building	Use	Remainder
Equipment	Volume stored/total volume	Remainder
Bonds and licenses:		
Managers bond	Volume stored/total volume	Remainder
Elevator bond	Percent of capacity utilized for storage	Remainder
Warehouse license	Volume stored/total volume	Remainder
Site rent	Volume stored/total volume	Remainder

Note: Building use--last building listed under each model in table 2 used first in the storage operation.

Total volume--Includes stored, merchandised, and handled grain.

Appendix table 2.--Method used in allocating variable expenses to models

Expense item	How expenses were allocated to:	
	Storage	Merchandising
Personnel:		
Manager, assistant manager, elevator man, and bookkeeper	Volume stored/total volume	Remainder
Extra labor	None	All
Advertising	None	All
Dues and subscriptions	None	All
Exchange (Bank Service Charge)	None	All
Heat	None	All
Interest--seasonal capital	None	All
Legal	None	All
Telephone and telegraph	None	All
Water	None	All
Miscellaneous	None	All
Auditing	Volume stored/total volume	Remainder
Director's fees	Volume stored/total volume	Remainder
Donations	Volume stored/total volume	Remainder
Elevator supplies	Volume stored/total volume	Remainder
Lights	Volume stored/total volume	Remainder
Meetings and member relations	Volume stored/total volume	Remainder
Office supplies	Volume stored/total volume	Remainder
Scales	Volume stored/total volume	Remainder
Travel and conventions	Volume stored/total volume	Remainder
Repairs and maintenance	Volume stored/total volume	Remainder
Power	Volume stored/total volume	Remainder
Insurance--grain and supplies	Building use	1/ Building use

1/ Based on 10 percent of model capacity above that utilized for storage.

Appendix table 3.--Method used in allocating nonoperating expenses to models

Expense item	How expenses were allocated to:	
	Storage	Merchandising
Shrinkage	.00755¢ per bu. stored	.003775¢ per bu.
Quality deterioration	.0025¢ per bu. stored	None
Interest:		
Building	Use	Remainder
Machinery	Volume stored/ total volume	Remainder
Other assets	None	All

Appendix table 4.--Total expenses separated into fixed, variable, and nonoperating, by model and function

Model	Total volume	Volume merchandised	Merchandising costs				Volume Stored	Storage costs				Total expense
			Fixed	Variable	Non-operating	Total		Fixed	Variable	Non-operating	Total	
	1,000 bu.	Bushels	Dollars				Bushels	Dollars				
	200	145,000	$5,570	$10,436	$6,342	$22,348	55,000	$3,180	$3,951	$2,728	$9,859	$32,207
	300	245,000	5,923	11,510	6,858	24,291	55,000	2,827	2,967	2,590	8,384	32,675
	400	345,000	6,100	12,092	7,304	25,496	55,000	2,650	2,473	2,521	7,644	33,140
	200	135,000	4,881	9,891	5,764	20,536	65,000	3,869	4,661	3,369	11,899	32,435
100	300	235,000	5,297	11,143	6,305	22,745	65,000	3,452	3,498	3,205	10,155	32,900
	400	335,000	5,508	11,813	6,765	24,086	65,000	3,242	2,915	3,123	9,280	33,366
	200	125,000	4,081	9,346	5,041	18,468	75,000	4,669	5,361	4,155	14,185	32,653
	300	225,000	4,563	10,777	5,606	20,946	75,000	4,187	4,021	3,967	12,175	33,121
	400	325,000	4,804	11,534	6,079	22,417	75,000	3,946	3,346	3,872	11,164	33,581
	300	214,750	7,097	11,632	8,184	26,913	85,250	2,955	3,845	2,999	9,799	36,712
	400	314,750	7,372	12,557	8,668	28,597	85,250	2,680	3,009	2,892	8,581	37,178
	500	414,750	7,537	13,144	9,111	29,792	85,250	2,515	2,509	2,827	7,851	37,643
	300	199,250	5,980	11,012	7,125	24,117	100,750	4,072	4,708	4,155	12,935	37,052
155	400	299,250	6,303	12,087	7,630	26,020	100,750	3,748	3,723	4,028	11,499	37,519
	500	399,250	6,500	12,765	8,083	27,348	100,750	3,552	3,130	3,952	10,634	37,982
	300	183,750	4,863	10,390	6,066	21,319	116,250	5,189	5,573	5,312	16,074	37,393
	400	283,750	5,238	11,618	6,589	23,445	116,250	4,814	4,436	5,166	14,416	37,861
	500	383,750	5,463	12,386	7,055	24,904	116,250	4,589	3,751	5,078	13,418	38,322
	600	495,500	7,231	17,581	8,872	33,684	104,500	4,204	4,605	4,239	13,048	46,732
	700	595,500	7,329	18,043	9,287	34,659	104,500	4,106	4,211	4,201	12,518	47,177
	800	695,500	7,402	18,405	9,693	35,500	104,500	4,033	3,912	4,173	12,118	47,618
	600	476,500	6,542	17,068	8,283	31,893	123,500	4,893	5,439	4,947	15,279	47,172
190	700	576,500	6,657	17,599	8,705	32,961	123,500	4,778	4,971	4,902	14,651	47,612
	800	676,500	6,744	18,012	9,116	33,872	123,500	4,691	4,621	4,869	14,181	48,053
	600	457,500	5,851	16,553	7,693	30,097	142,500	5,584	6,270	5,656	17,510	47,607
	700	557,500	5,984	17,153	8,123	31,260	142,500	5,451	5,733	5,604	16,788	48,048
	800	657,500	6,084	17,621	8,538	32,243	142,500	5,351	5,328	5,566	16,245	48,488

(continued)

Appendix table 4.--(continued) Total expenses separated into fixed, variable, and nonoperating, by model and function

Model	Total Volume	Volume merchandised	Merchandising costs				Volume stored	Storage costs				Total expense
			Fixed	Variable	Non-operating	Total		Fixed	Variable	Non-operating	Total	
	1,000 bu.	Bushels	Dollars				Bushels	Dollars				
265	700	554,250	$9,766	$18,522	$11,816	$40,104	145,750	$7,183	$4,487	$7,615	$19,285	$59,389
	800	654,250	9,898	19,037	12,248	41,183	145,750	7,051	4,033	7,561	18,645	59,828
	900	754,250	10,000	19,453	12,667	42,120	145,750	6,949	3,678	7,519	18,146	60,266
	700	527,750	8,460	17,842	10,597	36,899	172,250	8,489	5,301	9,001	22,791	59,690
	800	627,750	8,616	18,440	11,039	38,095	172,250	8,333	4,763	8,937	22,033	60,128
	900	727,750	8,737	18,918	11,466	39,121	172,250	8,212	4,346	8,887	21,445	60,566
	700	501,250	7,154	17,164	9,379	33,697	198,750	9,795	6,111	10,386	26,292	59,989
	800	601,250	7,334	17,844	9,831	35,009	198,750	9,615	5,492	10,312	25,419	60,428
	900	701,250	7,473	18,402	10,266	36,141	198,750	9,476	5,010	10,254	24,740	60,881
325	1,100	921,250	11,407	24,651	14,955	51,013	178,750	6,598	4,848	7,235	18,681	69,694
	1,200	1,021,250	11,484	24,966	15,364	51,814	178,750	6,521	4,594	7,203	18,318	70,132
	1,300	1,121,250	11,549	25,243	15,769	52,561	178,750	6,456	4,378	7,176	18,010	70,571
	1,100	888,750	10,156	24,072	13,754	47,982	211,250	7,849	5,594	8,639	22,082	70,064
	1,200	988,750	10,246	24,435	14,170	48,851	211,250	7,759	5,292	8,601	21,652	70,503
	1,300	1,088,750	10,324	24,750	14,578	49,652	211,250	7,681	5,038	8,570	21,289	70,941
	1,100	856,250	8,526	23,493	11,905	43,924	243,750	9,479	6,341	10,691	26,511	70,435
	1,200	956,250	8,631	23,902	12,327	44,860	243,750	9,374	5,993	10,647	26,014	70,874
	1,300	1,056,250	8,720	24,256	12,740	45,716	243,750	9,285	5,700	10,611	25,596	71,312
380	1,200	991,000	12,031	25,512	15,623	53,166	209,000	7,517	5,904	8,133	21,554	74,720
	1,300	1,091,000	12,108	25,833	16,032	53,973	209,000	7,440	5,644	8,102	21,186	75,159
	1,400	1,191,000	12,174	26,117	16,436	54,727	209,000	7,374	5,420	8,075	20,869	75,596
	1,200	953,000	10,721	24,696	14,466	49,883	247,000	8,827	7,177	9,530	25,534	75,417
	1,300	1,053,000	10,814	25,064	14,881	50,759	247,000	8,735	6,870	9,492	25,097	75,856
	1,400	1,153,000	10,890	25,389	15,291	51,570	247,000	8,658	6,606	9,460	24,724	76,294
	1,200	915,000	9,160	23,789	12,877	45,826	285,000	10,388	8,259	11,356	30,003	75,829
	1,300	1,015,000	9,265	24,206	13,298	46,769	285,000	10,283	7,903	11,313	29,499	76,268
	1,400	1,115,000	9,355	24,570	13,712	47,637	285,000	10,193	7,599	11,276	29,068	76,705

Appendix table 5.--Total expense per bushel for various volumes of grain merchandised and stored, for each elevator model

Model	Total volume	Volume merchandised	Merchandising costs per bushel				Volume Stored	Storage costs per bushel			
			Fixed	Variable	Non-operating	Total		Fixed	Variable	Non-operating	Total
	1,000 bu.	Bushels	Cents per bushel				Bushels	Cents per bushel			
100	200	145,000	3.84	7.20	4.37	15.41	55,000	5.78	7.18	4.96	17.92
	300	245,000	2.42	4.69	2.80	9.91	55,000	5.14	5.39	4.71	15.24
	400	345,000	1.77	3.50	2.12	7.39	55,000	4.82	4.50	4.58	13.90
	200	135,000	3.61	7.33	4.27	15.21	65,000	5.95	7.17	5.19	18.31
	300	235,000	2.26	4.74	2.68	9.68	65,000	5.31	5.38	4.93	15.62
	400	335,000	1.64	3.53	2.02	7.19	65,000	4.99	4.49	4.80	14.28
	200	125,000	3.26	7.48	4.03	14.77	75,000	6.22	7.15	5.54	18.91
	300	225,000	2.03	4.79	2.49	9.31	75,000	5.58	5.36	5.29	16.23
	400	325,000	1.48	3.55	1.87	6.90	75,000	5.26	4.46	5.16	14.88
155	300	214,750	3.30	5.42	3.81	12.53	85,250	3.46	4.51	3.52	11.49
	400	314,750	2.34	3.99	2.76	9.09	85,250	3.14	3.53	3.39	10.06
	500	414,750	1.82	3.17	2.19	7.18	85,250	2.95	2.94	3.32	9.21
	300	199,250	3.00	5.53	3.57	12.10	100,750	4.04	4.67	4.13	12.84
	400	299,250	2.11	4.04	2.55	8.70	100,750	3.72	3.69	4.00	11.41
	500	399,250	1.63	3.20	2.02	6.85	100,750	3.52	3.11	3.92	10.55
	300	183,750	2.65	5.65	3.30	11.60	116,250	4.47	4.79	4.57	13.83
	400	283,750	1.85	4.09	2.32	8.26	116,250	4.14	3.82	4.44	12.40
	500	383,750	1.42	3.23	1.84	6.49	116,250	3.95	3.22	4.37	11.54
190	600	495,500	1.46	3.55	1.79	6.80	104,500	4.02	4.41	4.06	12.49
	700	595,500	1.23	3.03	1.56	5.82	104,500	3.93	4.03	4.02	11.98
	800	695,500	1.06	2.65	1.39	5.10	104,500	3.86	3.75	3.99	11.60
	600	476,500	1.37	3.58	1.74	6.69	123,500	3.96	4.40	4.01	12.37
	700	576,500	1.16	3.05	1.51	5.72	123,500	3.87	4.02	3.97	11.86
	800	676,500	1.00	2.66	1.35	5.01	123,500	3.80	3.74	3.94	11.48
	600	457,500	1.28	3.62	1.68	6.58	142,500	3.92	4.40	3.97	12.29
	700	557,500	1.07	3.08	1.46	5.61	142,500	3.83	4.02	3.93	11.78
	800	657,500	.92	2.68	1.30	4.90	142,500	3.76	3.74	3.90	11.40

(continued)

Appendix table 5.--(continued) Total expenses per bushel for various volumes of grain merchandised and stored, for each elevator model

Model	Total volume	Volume merchandised	Merchandising costs per bushel				Volume stored	Storage costs per bushel			
			Fixed	Variable	Non-operating	Total		Fixed	Variable	Non-operating	Total
	1,000 bu.	Bushels	Cents per bushel				Bushels	Cents per bushel			
265	700	554,250	1.76	3.34	2.13	7.23	145,750	4.93	3.08	5.22	13.23
	800	654,250	1.51	2.91	1.87	6.29	145,750	4.84	2.77	5.18	12.79
	900	754,250	1.32	2.58	1.68	5.58	145,750	4.77	2.52	5.16	12.45
	700	527,750	1.60	3.38	2.01	6.99	172,250	4.93	3.08	5.22	13.23
	800	627,750	1.37	2.94	1.76	6.07	172,250	4.84	2.76	5.19	12.79
	900	727,750	1.20	2.60	1.58	5.38	172,250	4.77	2.52	5.16	12.45
	700	501,250	1.43	3.42	1.87	6.72	198,750	4.93	3.07	5.23	13.23
	800	601,250	1.22	2.97	1.63	5.82	198,750	4.84	2.76	5.19	12.79
	900	701,250	1.07	2.62	1.46	5.15	198,750	4.77	2.52	5.16	12.45
325	1,100	921,250	1.24	2.68	1.62	5.54	178,750	3.69	2.71	4.05	10.45
	1,200	1,021,250	1.12	2.45	1.50	5.07	178,750	3.65	2.57	4.03	10.25
	1,300	1,121,250	1.03	2.25	1.41	4.69	178,750	3.61	2.45	4.02	10.08
	1,100	888,750	1.14	2.71	1.55	5.40	211,250	3.71	2.65	4.09	10.45
	1,200	988,750	1.04	2.47	1.43	4.94	211,250	3.67	2.51	4.07	10.25
	1,300	1,088,750	.95	2.27	1.34	4.56	211,250	3.64	2.38	4.06	10.08
	1,100	856,250	1.00	2.74	1.39	5.13	243,750	3.89	2.60	4.39	10.88
	1,200	956,250	.90	2.50	1.29	4.69	243,750	3.84	2.46	4.37	10.67
	1,300	1,056,250	.82	2.30	1.21	4.33	243,750	3.81	2.34	4.35	10.50
380	1,200	991,000	1.21	2.57	1.58	5.36	209,000	3.60	2.82	3.89	10.31
	1,300	1,091,000	1.11	2.37	1.47	4.95	209,000	3.56	2.70	3.88	10.14
	1,400	1,191,000	1.02	2.19	1.38	4.59	209,000	3.53	2.59	3.86	9.98
	1,200	953,000	1.12	2.59	1.52	5.23	247,000	3.57	2.91	3.86	10.34
	1,300	1,053,000	1.03	2.38	1.41	4.82	247,000	3.54	2.78	3.84	10.16
	1,400	1,153,000	.94	2.20	1.33	4.47	247,000	3.51	2.67	3.83	10.01
	1,200	915,000	1.00	2.60	1.41	5.01	285,000	3.65	2.90	3.98	10.53
	1,300	1,015,000	.91	2.39	1.31	4.61	285,000	3.61	2.77	3.97	10.35
	1,400	1,115,000	.84	2.20	1.23	4.27	285,000	3.58	2.66	3.96	10.20

Other Publications Available

New Country Elevators--Influence of Size and Volume on Operating Costs, FCS Circular 10. Thomas E. Hall.

Economics of Grain Drying at Kansas Local Elevators, Marketing Research Report 449. J. C. Eiland and L. Orlo Sorenson.

Cooperative Country Elevators in Montana, FCS General Report 64. Francis P. Yager

What Influences Off-Farm Grain Sales in Missouri?, FCS General Report 91. Francis P. Yager.

Wheat Storage. A Study of Conditioning and Quality Maintenance Practices and Costs at Kansas Local Elevators. Kansas Agricultural Experiment Station Bulletin 399. L. Orlo Sorenson and Stanley K. Thurston.

A copy of each of these publications may be obtained upon request while the supply is available from:

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